PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-305099

(43)Date of publication of application : 02.11.2000

(51)Int.Cl. G02F 1/1343
G02F 1/1333
G02F 1/1335
G02F 1/1365
G09F 9/00

(21)Application number : 11-116384

(22)Date of filing : 23.04.1999

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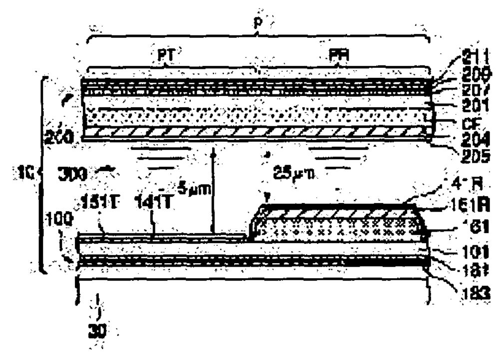
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a liquid crystal display device which can display an image high in picture quality both in dark and bright places and which can reduce the power consumption.

SOLUTION: A reflecting part PR and a transmitting part PT are formed in one pixel region P. In a bright place, external light is selectively reflected by the reflecting part PR to display an image, while in a dark place, the back light emitted from a back light unit 30 is selectively transmitted by the transmitting part PT to display an image. The thickness of the liquid crystal layer in the reflecting part PR is smaller than the thickness of the liquid crystal layer in the transmitting part PT and is specified to almost half of the thickness in the transmitting part.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

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CLAIMS

[Claim(s)]
[Claim 1] The 1st substrate which has the switching element which supplies a driving signal to the aforementioned pixel electrode while being arranged at the pixel electrode arranged to the pixel field divided by the scanning line arranged by the line writing direction on 1 principal plane, the signal line arranged in the direction of a train so that it might intersect perpendicularly with these scanning lines, the aforementioned scanning line, and the signal line, and the intersection of the aforementioned scanning line and a signal line. The 2nd substrate which has the counterelectrode arranged on 1 principal plane. The liquid crystal layer containing the liquid crystal constituent pinched between the 1st substrate of the above, and the 2nd substrate. It is the liquid crystal display equipped with the above, and the aforementioned pixel field is equipped with the reflective section which performs a reflective display, and the transparency section which performs a transparency display, and is characterized by the aforementioned liquid crystal layer thickness in the aforementioned reflective section differing from the aforementioned liquid crystal layer thickness in the aforementioned transparency section.
[Claim 2] It sets in the aforementioned transparency section and the phase contrast which the aforementioned liquid crystal layer makes an incident light produce between an ON state and an OFF state is -(2N-1) pi/2. (N is the natural number)
Come out, and it is, it sets in the aforementioned reflective section, and is -(2M-1) pi/4. (M is the natural number)
The liquid crystal display according to claim 1 which comes out and is characterized by a certain thing.
[Claim 3] It is the liquid crystal display according to claim 1 characterized by the field where the 1st substrate of the above counters the aforementioned liquid crystal layer being a concavo-convex field while the 2nd substrate of the above has the substantially flat field which counters the aforementioned liquid crystal layer.
[Claim 4] The aforementioned reflective section is a liquid crystal display according to claim 1 characterized by having the bump who projected from the aforementioned transparency section.
[Claim 5] The aforementioned reflector is a liquid crystal display according to claim 4 characterized by being prepared on the aforementioned bump.
[Claim 6] The aforementioned reflector is a liquid crystal display according to claim 4 characterized by being prepared in the aforementioned bump's lower layer.
[Claim 7] The aforementioned reflective section is a liquid crystal display according to claim 1 characterized by having the reflector prepared on two or more bumps who projected from the aforementioned transparency section.
[Claim 8] The liquid crystal display according to claim 1 characterized by having arranged the reflector and having arranged the transparency electrode at the aforementioned transparency section at the aforementioned reflective section.
[Claim 9] The aforementioned transparency electrode is a liquid crystal display according to claim 8 characterized by extending in the aforementioned reflective section and being superimposed with the aforementioned reflector.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to a liquid crystal display, and relates to the transflective type liquid crystal display which has the transparency section which displays a picture by reflecting outdoor daylight in a 1-pixel field especially by penetrating the reflective section and back light light which display a picture.
[0002]
[Description of the Prior Art] It has the liquid crystal layer containing the liquid crystal constituent pinched between the array substrate which has the pixel electrode connected electrically generally to the switching element arranged near the intersection of the scanning line arranged so that a liquid crystal display might intersect perpendicularly mutually, and a signal line, and this switching element, the opposite substrate which has a counterelectrode, and an array substrate and an opposite substrate.
[0003] The transflective type liquid crystal display is equipped with the reflective section which has a reflector in a 1-pixel field, and the transparency section which has a transparency electrode. A reflector and a transparency electrode are pixel electrodes connected to the switching element, and the same driver voltage is supplied.
[0004] Such a transflective type liquid crystal display has the merit which can reduce power consumption sharply in a dark place by turning on a back light, making it function as a penetrated type liquid crystal display which displays a picture using the transparency section in a pixel field, and making it function as a reflected type liquid crystal display which displays a picture by reflecting outdoor daylight using the reflective section in a pixel field in a bright place.
[0005]
[Problem(s) to be Solved by the Invention] However, the following problems arise in such a transflective LCD. That is, when making it function as a reflected type liquid crystal display, it is reflected by the reflector and a picture is again displayed by passing a liquid crystal layer, after outdoor daylight passes a liquid crystal layer. On the other hand, when making it function as a penetrated type liquid crystal display, a picture is displayed when back light light passes a liquid crystal layer once.
[0006] If it is based on an actual optical path and the phase contrast of the reflective section of a liquid crystal display which has single liquid crystal thickness, and the transparency section is considered at this time, in the reflective section, it will become the double precision of the transparency section. For this reason, when it is, for example, going to give pi/2 of phase contrast to the light which passes a liquid crystal layer once in the transparency section, in the reflective section, two-times passage of the liquid crystal layer is carried out, namely, the phase contrast of the light which goes and comes back to a liquid crystal layer is set to pi.
[0007] Therefore, in the transparency section, even if the contrast of a foreground color is controllable by carrying out modulation control of the light which passes a liquid crystal layer, in the reflective section, the light which passes a liquid crystal layer always serves as monochromatic specification of the same contrast, or a black display, and a practical display mode will not exist. Thereby, it falls under the influence of the display of the contrast of the foreground color displayed in the transparency section [in the same pixel field] of the reflective section, and the problem from which it becomes difficult to display a high definition picture occurs.
[0008] It is in offering the liquid crystal display which this invention can be made in view of the trouble mentioned above, and the purpose can display a high definition picture in a dark place and a bright place, and can reduce power consumption.
[0009]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem and to attain the purpose, a liquid crystal display according to claim 1 The scanning line arranged by the line writing direction on 1 principal plane,

the signal line arranged in the direction of a train so that it might intersect perpendicularly with these scanning lines, The 1st substrate which has the switching element which supplies a driving signal to the aforementioned pixel electrode while being arranged at the pixel electrode arranged to the pixel field divided by the aforementioned scanning line and the signal line, and the intersection of the aforementioned scanning line and a signal line, In the liquid crystal display equipped with the liquid crystal layer containing the liquid crystal constituent pinched between the 2nd substrate which has the counterelectrode arranged on 1 principal plane, and the 1st substrate of the above and the 2nd substrate the aforementioned pixel field It has the reflective section which performs a reflective display, and the transparency section which performs a transparency display, and the aforementioned liquid crystal layer thickness in the aforementioned reflective section is characterized by differing from the aforementioned liquid crystal layer thickness in the aforementioned transparency section.

[0010]

[Embodiments of the Invention] Hereafter, the gestalt of 1 operation of the liquid crystal display of this invention is explained with reference to a drawing.

[0011] Drawing 1 is the perspective diagram showing roughly an example of the liquid crystal display panel applied to the liquid crystal display of this invention.

[0012] The liquid crystal display concerning the gestalt of 1 implementation of this invention is active-matrix type transflective type electrochromatic display display, and is equipped with the liquid crystal display panel 10 and the back light unit 30.

[0013] The liquid crystal display panel 10 is equipped with the liquid crystal layer 300 containing the liquid crystal constituent arranged between the array substrate 100 as the 1st substrate, the opposite substrate 200 as the 2nd substrate by which opposite arrangement was carried out at this array substrate 100, and the array substrate 100 and the opposite substrate 200 as shown in drawing 1 and drawing 2 . In such a liquid crystal display panel 10, the display area 102 which displays a picture was formed in the field surrounded by the sealant 106 which sticks the array substrate 100 and the opposite substrate 200, and is equipped with two or more pixel fields. The circumference area 104 which has the various circuit patterns pulled out out of the display area 102 is formed in the field of the outside of a sealant 106.

[0014] As the display area 102 of the array substrate 100 is shown in drawing 2 or drawing 4 The m scanning lines Y1-Ym by which the transparent insulating substrate, for example, thickness, was formed along with the line writing direction of the pixel electrode 151 of the mxn individual arranged in the shape of a matrix, and these pixel electrode 151 on the glass substrate 101 which is 0.7mm, n signal lines X1-Xn formed along the direction of a train of these pixel electrode 151, It corresponds to the pixel electrode 151 of an mxn individual. near the intersection position of the scanning lines Y1-Ym and signal lines X1-Xn as a nonlinear switching element It has the scanning-line drive circuit 18 which drives m auxiliary capacity lines 52 arranged in parallel with the scanning lines Y1-Ym of 121 or m TFT of the arranged mxn individual, i.e., TFT, and the scanning lines Y1-Ym, and the signal-line drive circuit 19 which drives these signal lines X1-Xn.

[0015] The scanning line is formed of low electrical resistance materials, such as aluminum and a molybdenum-tungsten alloy. The signal line is formed of low electrical resistance materials, such as aluminum.

[0016] With the gestalt of implementation of the 1st of this invention, as shown in drawing 3 and drawing 4 , the pixel field P is equivalent to the field divided by the scanning line Y prepared in general in the array substrate 100, and the signal line X. The 1-pixel field P has the transparency section PT which displays a picture by reflecting outdoor daylight alternatively by penetrating alternatively the back light light from the reflective section PR and the back light unit 30 which displays a picture.

[0017] The reflective section PR is equipped with the bump 161 formed of the acrylic resin resist, and reflector 151R formed with metallic-reflection films, such as aluminum prepared on this bump 161.

[0018] The transparency section PT is equipped with transparency electrode 151T formed of transparent conductivity members, such as indium-teens-oxide, i.e., ITO etc.

[0019] Reflector 151R and transparency electrode 151T function as a pixel electrode 151 electrically connected to the source electrode of TFT121.

[0020] As shown in drawing 5 , TFT121 is a top gate type and has the semiconductor film 122 which consists of a polysilicon contest film formed on the glass substrate 101. This semiconductor film 122 has active-region 122A, source field 122S by which the impurity dope was carried out, and drain field 122D. The front face of this semiconductor film 122 and a glass substrate 101 is the silicon-oxide film 2, i.e., SiO. It is covered by the formed gate insulator layer 123.

[0021] On the gate insulator layer 123 located in right above [of active-region 122A], the gate electrode 124 which projected from the scanning line Y is arranged. This gate electrode 124 and the gate insulator layer 123 are the silicon-oxide film 2, i.e., SiO. It is covered with the formed layer insulation film 125. The scanning line Y containing this gate

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parallel electrically with the liquid crystal capacity CL. That is, the auxiliary capacity CS is formed of the potential difference formed between the pixel electrode 151, the auxiliary capacity electrode 61 of this potential, and the auxiliary capacity line 52 set as predetermined potential.
[0040] lambda / 4 phase-contrast board 181, and the polarizing plate 183 are arranged by the external surface of the glass substrate 101 of the array substrate 100. The optical diffusion film 207, the lambda / 4 phase-contrast board 209, and the polarizing plate 211 are arranged by the external surface of the glass substrate 201 of the opposite substrate 200. Although the optimal direction is chosen according to the display mode of a liquid crystal display, the twist angle of a liquid crystal constituent, etc., the deviation side of polarizing plates 183 and 211 is arranged with the form of this operation so that a deviation side may become parallel mutually.
[0041] The back light unit 30 shown in drawing 4 is arranged at the tooth back of the array substrate 100 in the liquid crystal display panel 10. This back light unit 30 has optical sheets, such as a prism sheet arranged between the light guide plate which has the cross section of a wedge action die, the light source arranged in the unilateral side of this light guide plate, the reflecting plate surrounding this light source, and a light guide plate and an array substrate, etc., and is constituted.
[0042] The gap of the liquid crystal layer thickness by which the liquid crystal constituent 300 is pinched, i.e., the predetermined width of face formed between the array substrate 100 and the opposite substrate 200, is secured by the spacer arranged to non-pixel fields, such as circuit patterns, such as a signal line X and the scanning line Y, TFT121, the pixel electrode 151, and the circumference frame section.
[0043] This liquid crystal layer thickness is about 5 micrometers in the transparency section PT of the pixel field P in the example shown in drawing 4 .
[0044] In the reflective section PR of the pixel field P, since the lower layer of reflector 151R and reflector 151R is equipped with about 1 or the thickness of 5 micrometers, and the bump 161 that has the thickness of about 2.5 micrometers with the form of this operation, liquid crystal layer thickness [in / the reflective section PR / unlike the liquid crystal layer thickness in the transparency section PT] is about 2.5 micrometers.
[0045] That is, the field which counters the liquid crystal layer 300 by having the array substrate 100 to the opposite substrate 200 having the substantially flat field which counters the liquid crystal layer 300 in the bump 161 who projected from the transparency section PT in the reflective section PR is a concavo-convex field. For this reason, the phase contrast of one way of the light which passes a liquid crystal layer will be equivalent to the double precision of the reflective section PR in the transparency section PT.
[0046] In the transparency section PT, after passing the liquid crystal layer 300, it is reflected by reflector 151R, and again, after the light which carried out incidence from the opposite substrate 200 side in the reflective section PR to the light by which outgoing radiation was carried out from the back light unit 30 passing the liquid crystal layer 300 once passes the liquid crystal layer 300, outgoing radiation of it is carried out from the opposite substrate 200. Therefore, the phase contrast of the light which passes the light which passes the liquid crystal layer of the transparency section PT, and the liquid crystal layer of the reflective section PT becomes equal substantially.
[0047] Thus, in the transparency section PT, since the outdoor daylight from the opposite substrate 200 side will carry out two-times passage of the liquid crystal layer 300 in the reflective section PR to back light light penetrating the liquid crystal layer 300 only once, the thing of the thickness of the transparency section PT for which about 1/of thickness of the liquid crystal layer 300 of the reflective section PR is set to 2 is desirable.
[0048] Next, the manufacture method of this liquid crystal display is explained.
[0049] That is, in the transparency section PT, transparency electrode 151T are formed the whole surface on the glass substrate 101 with a thickness of 0.7mm by forming membranes by the sputtering method and carrying out patterning of the ITO thin film. These transparency electrode 151T are electrically connected to source electrode 127S of TFT121.
[0050] Then, orientation film 141T are formed by applying orientation film material on transparency electrode 151T, and performing rubbing processing. This orientation shaft of orientation film 141T is set as sense which becomes parallel mutually with the orientation shaft of the orientation film 205 prepared in the opposite substrate 200 side.
[0051] In the reflective section PR, a transparent ultraviolet-rays hardening type acrylic resin resist (product made from Fuji Hunt Technology) is applied the whole surface on a glass substrate 101 using a spinner, and it dries. Then, the photo mask of the predetermined pattern configuration corresponding to the reflective section PR of each pixel field P for this acrylic resin resist is used, and it is 100 mJ/cm2 at the wavelength of 365nm. After exposing with light exposure, negatives are developed for 70 seconds with a predetermined developer. And the bump 161 of 2.5 micrometers of thickness is formed by calcinating.
[0052] Then, on this bump 161, an aluminum thin film is formed by the sputtering method, and reflector 151R is formed. At this time, Reflector R is electrically connected to source electrode 127S of TFT121 by filling up with

aluminum the contact hole 128 formed in the bump 161. Then, this aluminum thin film carries out patterning to a predetermined pixel electrode configuration which remains on a bump 161. From this, reflector 151R is formed on a bump 161.
[0053] Molybdenum with a thickness of 100nm is formed in the lower layer of this reflector 151R in the same configuration as aluminum.
[0054] Then, orientation film 141R is formed by applying orientation film material on reflector 151R, and performing rubbing processing. The orientation shaft of this orientation film 141R is set as sense which intersects perpendicularly with the orientation shaft of the orientation film 205 prepared in the opposite substrate 200 side mutually.
[0055] On the other hand, on the glass substrate 201 with a thickness of 0.7mm, a counterelectrode 204 and the orientation film 205 are formed, respectively, and the opposite substrate 200 is formed.
[0056] Then, except for a liquid crystal inlet, a sealant 106 is printed along the orientation film 205 circumference of the opposite substrate 200. Furthermore, the electrode transition material for supplying voltage to the counterelectrode 204 by the side of [the array substrate 100 side to] the opposite substrate 200 is formed on the electrode transition electrode of the sealant 106 circumference.
[0057] Then, the array substrate 100 and the opposite substrate 200 are arranged and heated, a sealant 106 is stiffened so that the orientation films 141R, 141T, and 205 may counter mutually, and two substrates are stuck. At this time, a predetermined gap is formed between the array substrate 100 and the opposite substrate 200.
[0058] Then, what added and made the chiral agent the liquid crystal constituent 300 between the array substrate 100 and the opposite substrate 200 from the liquid crystal inlet is poured in, and a liquid crystal inlet is closed by ultraviolet-rays hardening resin. The poured-in liquid crystal constituent 300 forms the pneumatic liquid crystal layer of 90 twist angles with the orientation films 141R and 141T by the side of the array substrate 100, and the orientation film 205 by the side of the opposite substrate 200.
[0059] Liquid crystal layer thickness differs in the reflective section PR of the pixel field P, and the transparency section PT. That is, in the reflective section PR, the thickness from a part for a bump's 161 thickness and glass-substrate 101 front face becomes thicker than the transparency section PT, and liquid crystal layer thickness [in / the transparency section PT / to the liquid crystal layer thickness in the reflective section PR being 2.5 micrometers] is 5 micrometers.
[0060] For this reason, in the transparency section PT, by the time it penetrates the back light light which carried out incidence to the liquid crystal layer from the array substrate side to an opposite substrate side, it will produce pi/2 of phase contrast. In the reflective section PR, the outdoor daylight which carried out incidence to the liquid crystal layer produces pi/4 of phase contrast from an opposite substrate side in one way, and by the time outgoing radiation of the reflected light reflected by reflector 151R is carried out to an opposite substrate side, it will produce pi/2 of phase contrast both ways.
[0061] The laminating of lambda / 4 phase-contrast board 181, and the polarizing plate 183 is carried out to the superficies of the array substrate 100 at this order. Moreover, the laminating of the optical diffusion film 207, the lambda / 4 phase-contrast board 209, and the polarizing plate 211 is carried out to the superficies of the opposite substrate 200 at this order.
[0062] The circular polarization of light produced by passing a deflecting plate and passing a phase contrast board is changed into the circular polarization of light of the forward direction or an opposite direction by ON/OFF of the voltage to a liquid crystal layer. Thereby, after passing a phase contrast board again, passage / un-passing a polarizing plate are chosen. A picture is displayed by penetrating back light light alternatively in a dark place using this. Moreover, in a bright place, a picture is displayed by reflecting outdoor daylight alternatively.
[0063] Operation of such a transflective LCD is explained more to a detail.
[0064] First, the light which passes the liquid crystal layer 300 in the transparency section PT operates, as shown in (a) of drawing 6 in the state OFF, i.e., voltage, where the potential difference is not impressed to the liquid crystal layer 300. That is, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 183 among the back light light which carries out incidence from an array substrate side passes a polarizing plate 183. By passing lambda / 4 phase-contrast board 181, this linearly polarized light is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from an array substrate side.
[0065] By passing the liquid crystal layer 300 containing the liquid crystal constituent twisted at the predetermined angle, this left rotatory polarization produces pi/2 of phase delay, is changed into right handed rotation, and passes the glass substrate 201 by the side of an opposite substrate. This right handed rotation is again changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light is parallel to the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 passes a polarizing plate 211, and performs the Ming display of the

monochrome adapted to the color of a light filter CF.
[0066] On the other hand, the light which passes the liquid crystal layer 300 in the transparency section PT in the time of the state ON, i.e., voltage, where the potential difference was impressed to the liquid crystal layer 300 operates, as shown in (b) of drawing 6 . That is, a polarizing plate 183 is passed, and further, by passing lambda / 4 phase-contrast board 181, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 183 among the back light light which carries out incidence from an array substrate side like the time of voltage OFF is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from an array substrate side.
[0067] This left rotatory polarization passes the glass substrate 201 by the side of an opposite substrate, without receiving the phase modulation by the liquid crystal layer 300 by passing the liquid crystal layer 300 containing the liquid crystal constituent which was able to dispel twist structure. This left rotatory polarization is changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light intersects perpendicularly in the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 cannot pass a polarizing plate 211, but will perform a dark display, i.e., a black display.
[0068] On the other hand, the light which passes the liquid crystal layer 300 in the reflective section PR operates, as shown in (c) of drawing 6 in the state OFF, i.e., voltage, where the potential difference is not impressed to the liquid crystal layer 300. That is, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 211 among the outdoor daylight which carries out incidence from an opposite substrate side passes a polarizing plate 211. By passing lambda / 4 phase-contrast board 209, this linearly polarized light is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from the glass substrate 201 by the side of an opposite substrate.
[0069] By passing the liquid crystal layer 300 containing the liquid crystal constituent twisted at the predetermined angle, this left rotatory polarization produces pi/4 of phase delay, by being reflected by reflector 151R and passing the liquid crystal layer 300 again, by producing pi/4 of phase delay again, will be total and will produce pi/2 of phase delay. For this reason, the left rotatory polarization which carried out incidence from the opposite substrate side is changed into right handed rotation, and passes the glass substrate 201 by the side of an opposite substrate. This right handed rotation is again changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light is parallel to the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 passes a polarizing plate 211, and performs the Ming display of the monochrome adapted to the color of a light filter CF.
[0070] On the other hand, the light which passes the liquid crystal layer 300 in the reflective section PR in the time of the state ON, i.e., voltage, where the potential difference was impressed to the liquid crystal layer 300 operates, as shown in (d) of drawing 6 . That is, a polarizing plate 211 is passed, and further, by passing lambda / 4 phase-contrast board 209, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 211 among the outdoor daylight which carries out incidence from an opposite substrate side like the time of voltage OFF is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from the glass substrate 201 by the side of an opposite substrate.
[0071] This left rotatory polarization passes the glass substrate 201 by the side of an opposite substrate, without receiving the phase modulation by the liquid crystal layer 300 by passing the liquid crystal layer 300 containing the liquid crystal constituent which was able to dispel twist structure 1 ****. This left rotatory polarization is changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light intersects perpendicularly in the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 cannot pass a polarizing plate 211, but will perform a dark display, i.e., a black display.
[0072] In addition, both the light reflected in the light and the reflective section which penetrated the transparency section PT at the time of voltage OFF is diffused with the optical diffusion film 207, and can extend the viewing angle of the display screen. The particle distribution film (Dai Nippon Printing Co., Ltd. make : tradename IDC film) which distributed the spherical particle with the predetermined refractive index as an optical diffusion film in the medium which has another refractive index was used. In addition, even if it uses the optical diffusion film (Sumitomo Chemical Co., Ltd. make : tradename mill SUTI) which gives directivity to dispersion using the diffraction effect of light, the display brightness of a practical use region is easy to become high.
[0073] A transflective LCD equips the 1-pixel field P with the reflective section PR and the transparency section PT. thus, in a bright place It functions as a reflected type liquid crystal display which reflects outdoor daylight alternatively by the reflective section PR, and displays a picture. in a dark place By functioning as a penetrated type liquid crystal

display which turns on the back light unit 30, penetrates alternatively the back light light in which outgoing radiation was carried out by the transparency section PT from the back light unit 30, and displays a picture As compared with the case where a back light unit is always driven as a penetrated type liquid crystal display, it becomes possible to reduce power consumption sharply.

[0074] Moreover, the liquid crystal layer thickness in the transparency section is set up so that pi/2 of phase contrast may be given to the light which turns a liquid crystal layer to an opposite substrate side from an array substrate side, and passes. After turning a liquid crystal layer to an array substrate side from an opposite substrate side and passing, the liquid crystal layer thickness in the reflective section is set up so that pi/2 of phase contrast may be given to the light which passes towards an opposite substrate side from an array substrate side again. That is, in order to give such phase contrast, with the form of operation mentioned above, the liquid crystal layer thickness in the transparency section is set up the twice [about] of the liquid crystal layer thickness in the reflective section.

[0075] When modulation control of the light which passes a liquid crystal layer in the transparency section is carried out and the contrast of a foreground color is controlled by considering as such composition, in the reflective section, the same simultaneous and modulation control can be performed also to the light which passes a liquid crystal layer. Therefore, it becomes possible to display a high definition picture also in a bright place and a dark place [in the same pixel field], without influencing of a display the contrast of the foreground color displayed in either the transparency section or the reflective section by another side.

[0076] In addition, with the form of operation mentioned above, if it is the composition that pi/2 of phase contrast can be given to the light by which passes the transparency section and the reflective section and outgoing radiation is carried out from an opposite substrate side although the case where the liquid crystal layer thickness of the transparency section was larger than the liquid crystal layer thickness of the reflective section was explained as shown in (a) of drawing 6 , or (d), it will not be limited to this.

[0077] Namely, as shown in (a) of drawing 7 , or (d), even if it is the case that the liquid crystal layer thickness of the reflective section is larger than the liquid crystal layer thickness of the transparency section, what is necessary is just the composition that the conditions mentioned above are satisfied.

[0078] That is, the light which passes the liquid crystal layer 300 in the reflective section PR operates, as shown in (a) of drawing 7 at the time of the voltage OFF on which the potential difference is not impressed to the liquid crystal layer 300. That is, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 211 among the outdoor daylight which carries out incidence from an opposite substrate side passes a polarizing plate 211. By passing lambda / 4 phase-contrast board 209, this linearly polarized light is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from the glass substrate 201 by the side of an opposite substrate.

[0079] By passing the liquid crystal layer 300 containing the liquid crystal constituent twisted at the predetermined angle, this left rotatory polarization produces phase delay of 3pi/4, and when reflected by reflector 151R, it produces phase delay of 3pi/4 again. By this, it is total and phase delay of 3pi/2 is produced, and the left rotatory polarization which carried out incidence from the opposite substrate side is changed into right handed rotation, and passes the glass substrate 201 by the side of an opposite substrate. This right handed rotation is again changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light is parallel to the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 passes a polarizing plate 211, and performs the Ming display of the monochrome adapted to the color of a light filter CF.

[0080] On the other hand, the light which passes the liquid crystal layer 300 in the reflective section PR in the time of the voltage ON on which the potential difference was impressed to the liquid crystal layer 300 operates, as shown in (b) of drawing 7 . That is, a polarizing plate 211 is passed, and further, by passing lambda / 4 phase-contrast board 209, only the linearly polarized light of the predetermined direction parallel to the polarization direction of a polarizing plate 211 among the outdoor daylight which carries out incidence from an opposite substrate side like the time of voltage OFF is changed into the left rotatory polarization, and carries out incidence to the liquid crystal layer 300 from the glass substrate 201 by the side of an opposite substrate.

[0081] This left rotatory polarization passes the glass substrate 201 by the side of an opposite substrate, without receiving the phase modulation by the liquid crystal layer 300 by passing the liquid crystal layer 300 containing the liquid crystal constituent which was able to dispel twist structure 1 ****. This left rotatory polarization is changed into the linearly polarized light by passing lambda / 4 phase-contrast board 209. The polarization direction of this linearly polarized light intersects perpendicularly in the polarization direction of a deflecting plate 211. For this reason, the linearly polarized light changed by lambda / 4 phase-contrast board 209 cannot pass a polarizing plate 211, but will perform a dark display, i.e., a black display.

[0082] On the other hand, as shown in (c) of drawing 7 , the light which passes the liquid crystal layer 300 in the transparency section PT operates like the case where (a) of drawing 6 explains at the time of the voltage OFF on which the potential difference is not impressed to the liquid crystal layer 300. For this reason, a part of back light light which carries out incidence from an array substrate side passes a polarizing plate 211, and it performs the Ming display of the monochrome adapted to the color of a light filter CF.
[0083] On the other hand, as shown in (d) of drawing 7 , the light which passes the liquid crystal layer 300 in the transparency section PT in the time of the voltage ON on which the potential difference was impressed to the liquid crystal layer 300 operates like the case where (b) of drawing 6 explains. For this reason, the back light light which carries out incidence from an array substrate side cannot pass a polarizing plate 211, but will perform a dark display, i.e., a black display.
[0084] Thus, the phase contrast of one way of the light which passes a liquid crystal layer in the transparency section, i.e., the phase contrast which a liquid crystal layer makes the incident light (outdoor daylight) which carries out incidence to a liquid crystal layer produce between an ON state and an OFF state, is -(2N-1) pi/2. (however, N natural number)
The phase contrast which are set up so that it may become, and the incident light (back light light) in which a liquid crystal layer carries out incidence to a liquid crystal layer between an ON state and an OFF state is made to produce in the reflective section is -(2M-1) pi/4. (M is the natural number)
If it is set up so that it may become, it is possible to acquire the same effect as the form of operation mentioned above.
[0085] Next, the form of implementation of the 2nd of this invention is explained. In addition, about the same component as the form of operation mentioned above, the same reference number is attached and detailed explanation is omitted.
[0086] As shown in drawing 8 and drawing 9 , the pixel field P is equivalent to the field divided by the scanning line Y prepared in general in the array substrate 100, and the signal line X. The 1-pixel field P has the transparency section PT which displays a picture by reflecting outdoor daylight alternatively by penetrating alternatively the back light light from the reflective section PR and the back light unit 30 which displays a picture.
[0087] The reflective section PR is equipped with two or more pillar-shaped bumps 171 formed of the transparent acrylic resin resist, and reflector 151R formed with metallic-reflection films, such as aluminum prepared so that these bumps 171 might be covered. The pillar-shaped bump 171 who constitutes this reflective section PR is formed in the shape of [which has a circular cross section with a diameter of about 10 micrometers] a pillar, and is stationed in the pixel field at the random position. Moreover, the amount of [of the pillar-shaped bump 171] point has the radius of circle.
[0088] More, in the field in a circle with a diameter [on a bump 171] of about 8 micrometers, the laminating of an ITO film, a molybdenum film, and the aluminum film is carried out to this order, and the bump 171 constitutes the reflective section PR from a field outside it at the detail, when covered by only the ITO film.
[0089] The transparency section PT is equipped with transparency electrode 151T formed in the flat portion on a glass substrate 101 of transparent conductivity members, such as ITO.
[0090] Reflector 151R and transparency electrode 151T function as a pixel electrode 151 electrically connected to the source electrode of TFT121.
[0091] In the plan as shown in drawing 8 , the ratio of the area S1 of the portion of only ITO and the area S2 of the portion which prepared the aluminum film is set as S1:S2=2:1. In a cross section as shown in drawing 9 , the liquid crystal layer thickness in the transparency section PT is about 5 micrometers. The height of the pillar-shaped bump 171 who constitutes the reflective section PR is about 2.5 micrometers, and it is set up so that it may become abbreviation half [of the liquid crystal layer thickness in the transparency section PT].
[0092] In the transflective LCD which has such the transparency section and the reflective section, it can operate like the form of the 1st operation mentioned above at the time of voltage ON/OFF, and the same effect can be acquired. Moreover, with such composition, since reflector 151R is prepared on the pillar-shaped bump 171 who has a radius of circle, it can generate diffuse reflection light and can omit an optical diffusion film.
[0093] Next, the form of implementation of the 3rd of this invention is explained. In addition, about the same component as the form of operation mentioned above, the same reference number is attached and detailed explanation is omitted.
[0094] The difference with the form of operation of the 1st of the form of the 3rd operation is the vertical relation between a bump 172 and reflector 151R, as shown in drawing 10 . That is, reflector 151R in the reflective section PR is arranged on the glass substrate of the transparency electrode 151T and this layer in the transparency section PT. The bump 172 prepared in order to control the liquid crystal layer thickness in the reflective section PR is stationed on reflector 151R.

[0095] In the case of the form of the 1st operation, supposing it impresses the voltage of 4V as opposed to the liquid crystal layer of the transparency section PT, unlike 5V / 2.5 micrometers = 2v/micrometer, field strength will differ in the voltage-luminosity property in the transparency section and the reflective section practically by the transparency section in 5V / 5 micrometers = 1v /, and the reflective section. [micrometer]
[0096] With the form of this 3rd operation, on the other hand, field strength In the transparency section, in 5V / 5 micrometers = 1v /, and the reflective section [micrometer] It is set to (5V-5 Vxepsilon L/ (epsilonL+epsilonB))/2.5micrometer (however, in epsilonL, the average dielectric constant of a liquid crystal layer and epsilonB show a bump's dielectric constant, respectively), and a more practical voltage-luminosity property is acquired in the transparency section and the reflective section by choosing bump material suitably.
[0097] In addition, with the form of this 3rd operation, you may use a light filter instead of a bump.
[0098] It can operate like the form of the 1st operation which was mentioned above and which was mentioned above also in the form of the 3rd operation at the time of voltage ON/OFF, and the same effect can be acquired.
[0099] As mentioned above, according to the liquid crystal display of this invention, it has the transparency section in which a function is possible as a penetrated type liquid crystal display using the back light light from the back light unit arranged in a 1-pixel field at the tooth back using outdoor daylight with the reflective section in which a function is possible as a reflected type liquid crystal display, and it becomes possible to reduce power consumption on the occasion of use in a bright place and a dark place.
[0100] Moreover, the liquid crystal layer of the transparency section and the reflective section is passed, while being able to improve brightness by controlling liquid crystal layer thickness to the light by which outgoing radiation is carried out from an opposite substrate side so that pi/2 of phase delay can be given, respectively, the fall of contrast can be prevented and a high definition picture can be displayed.
[0101] In addition, in the form of operation mentioned above, although the liquid crystal layer containing a Twisted Nematic type, i.e., TN type, liquid crystal constituent was used, if it is the element which can control the phase contrast of an element by electric field in lambda/4 or more waves of range, the same effect will be acquired. For example, you may use the perpendicular orientation type pneumatic liquid crystal element to which the level orientation type pneumatic liquid crystal element to which orientation of the TN type liquid crystal constituent was carried out in parallel with the direction of a substrate could be used for, and orientation of the pneumatic liquid crystal was carried out at right angles to the direction of a substrate. Moreover, you may use what can carry out electric-field control of whether the phase of the polarization which carried out incidence to liquid crystal layers, such as an antiferroelectricity liquid crystal device and a ferroelectric liquid crystal element, is shifted lambda/4 in the clockwise direction, or it shifts lambda/4 in the counterclockwise direction.
[0102]
[Effect of the Invention] As explained above, according to this invention, in a dark place and a bright place, the liquid crystal display which can display a high definition picture and can reduce power consumption can be offered.

[Translation done.]

*.NOTICES *

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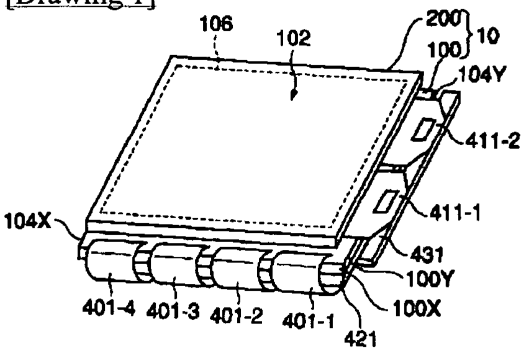
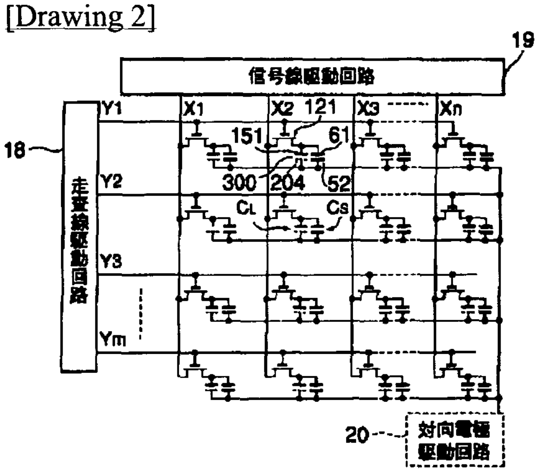
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

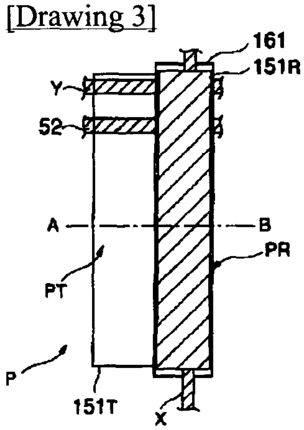
[Drawing 1]



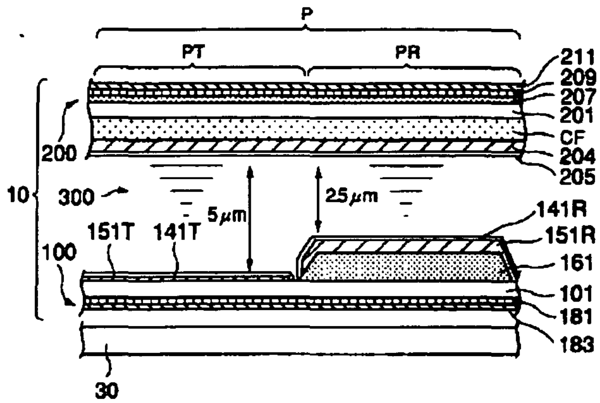
[Drawing 2]



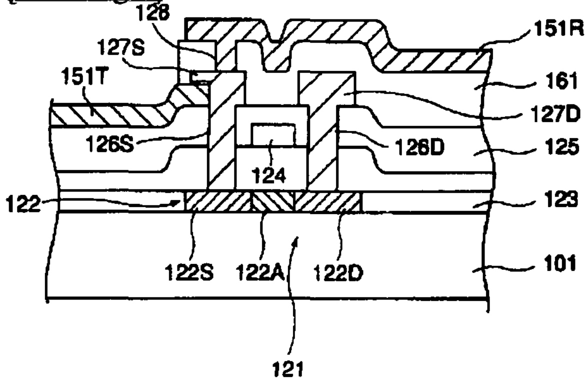
[Drawing 3]



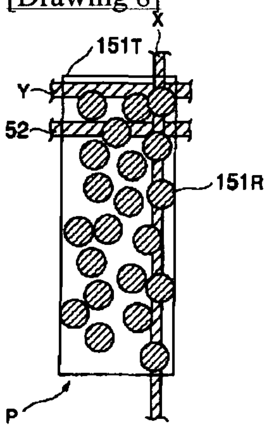
[Drawing 4]



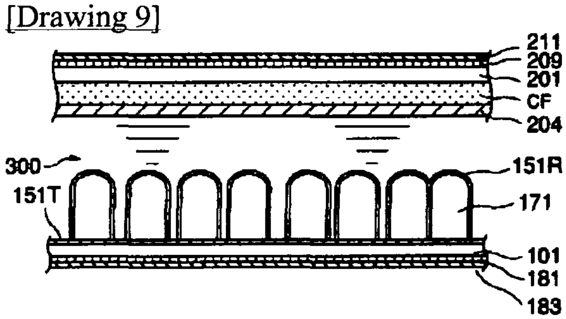
[Drawing 5]



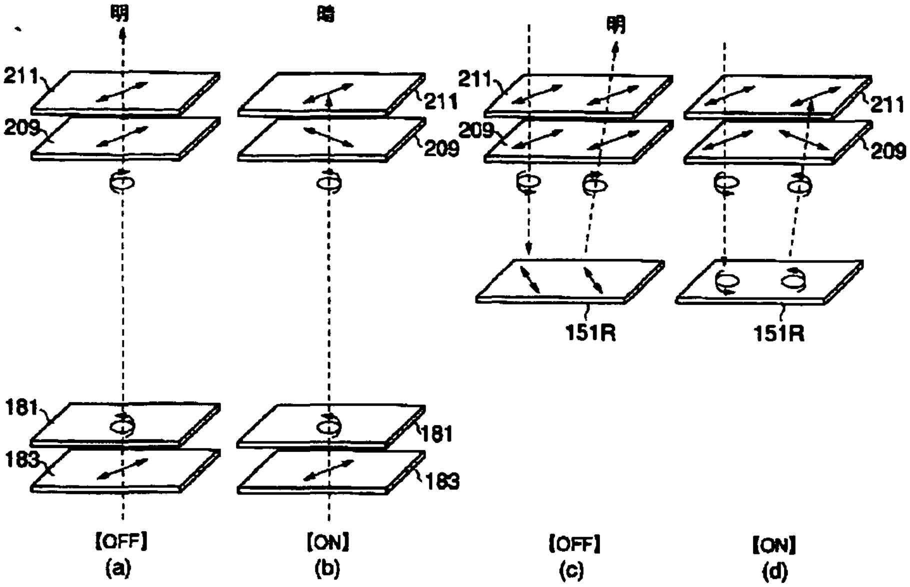
[Drawing 8]



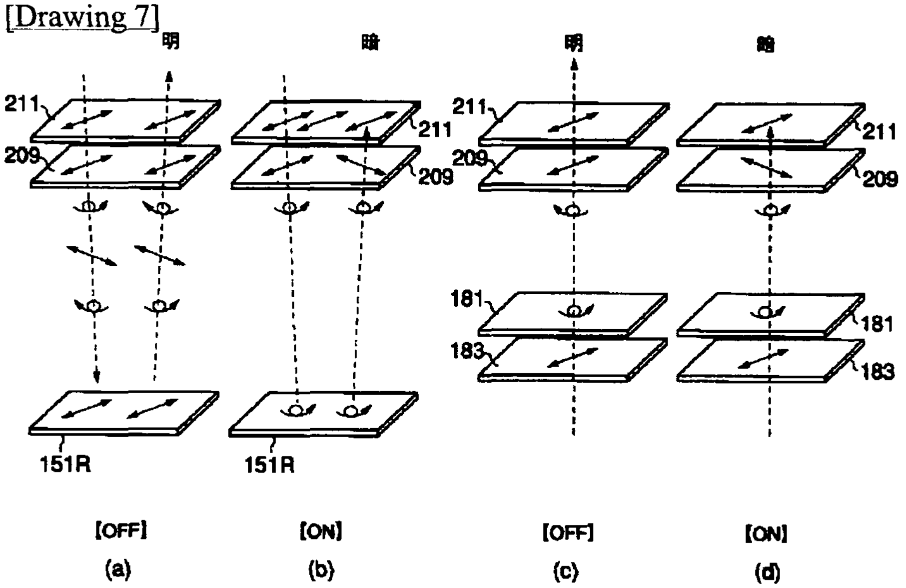
[Drawing 9]



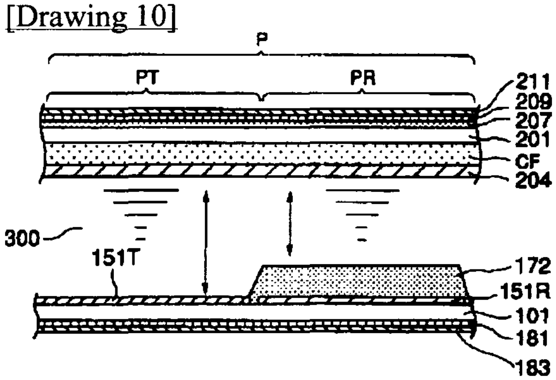
[Drawing 6]



[Drawing 7]



[Drawing 10]



[Translation done.]